Lower crustal magmatic processes: examination of isotopic compositions of Quaternary frontal arc volcanoes of NE Japan

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We examined the lower crustal magmatic processes beneath Quaternary frontal volcanoes of the NE Japan arc based on Sr–Nd–Hf–Pb isotopic compositions coupled with trace and major element compositions. The frontal arc is characterized by the coexistence of medium-K to low-K calc-alkaline and tholeiitic magma suites. The remarkable findings are quasi-linear isotopic trends in the Pb–Pb and Nd–Pb isotope space, which are distinctive of the magmas from individual volcanoes irrespective of their magma suites. The enriched magmas from volcanoes on the same segment of the basement share the same isotopic composition with their basement granitoids. Further, isotopic compositional variations in basalts cover whole range of the variations in each volcano. Examinations of these geochemical data led us to conclude the observed trends form mixing lines drawn between isotopically depleted metasomatized mantle-derived basalt and enriched mafic lower crustal materials or their melts, which are isotopically heterogeneous along the arc. Assimilation-fractional-crystallization (AFC) and melting-assimilation-storage-hybridization (MASH) are responsible for the intermediate to felsic compositional trends of the tholeiitic and calc-alkaline rock suites, respectively. These processes mostly occurred in an amphibolitic lower crust. The results demonstrate that the mafic lower crust extensively contributes to the diversity of the arc magmas of basalt to rhyolitic compositions. Role of the mafic lower crust to the geochemical variations of arc basalts is usually cryptic but the study of the magmas from NE Japan reveals its fundamental significance in diversity of arc magmas.

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